

What is claim d is:

1. A position measuring apparatus, comprising:

a position indicating means for indicating a position and a direction of a tool; and

5 a three-dimensional position measuring means for measuring a position and a direction of an surgical field and also the position and the direction of said tool, wherein said position indicating means and said three-dimensional position measuring means are fixed, so that relative positional relationship therebetween is constant.

10 2. A position measuring apparatus, as described in the claim 1, wherein said position indicating means comprises at least two (2) pieces of laser beam emitting means, each of which can control an emit angle of a laser beam thereof.

15 3. A position measuring apparatus, as described in the claim 2, wherein said position measuring apparatus is held on a stand, which is changeable, at least either one of a position and a direction thereof, thereby being movable while keeping the relative positional relationship between said position indicating means and said three-dimensional position measuring means.

20 4. A position measuring apparatus, as described in the claim 2, wherein said position measuring apparatus is held by an arm, which extends from a ceiling and is changeable at least either one of a position and a direction thereof, thereby being movable while keeping the relative positional relationship between said  
25 position indicating means and said three-dimensional position measuring means.

30 5. A position measuring apparatus, as described in the claim 1, wherein said position measuring apparatus is used for indicating a position and a direction of a surgical tool during a surgical operation.

6. A position measuring apparatus, as described in the claim 2, wherein said position measuring apparatus is used for indicating a position and a direction of a surgical tool during a surgical operation.

5           7. A position measuring apparatus, as described in the claim 2, further comprising means for calculating setting position and direction of said laser emitting means from the emit angle of the laser beam and a laser beam emitting position that is measured by said three-dimensional position measuring means.

10           8. A position measuring apparatus, comprising:

          a position indicating means being able to indicate a position and a direction of a tool;

          a three-dimensional position measuring means for measuring a position and a direction of a surgical field and also the position  
15   and the direction of said tool;

          at least two (2) pieces of laser beam emitting means, being provided in said position indicating means, each being controllable in an emit angle of the laser beam; and

          means for calculating a setting position and a direction  
20   of said laser beam emitting means from the emit angles of two (2) pieces of the laser beams and laser beam emitting positions which are measured by said three-dimensional position measuring means.

9. A position measuring apparatus, as described in the claim 8, further comprising means for identifying the setting position  
25   and direction of said laser beam emitting means from the emit angles of said two (2) pieces of laser beam emitting means and at least four (4) pieces of data on the laser beam emitting positions, which are measured by said three-dimensional position measuring means.

10           10. A position measuring apparatus, as described in the claim 8, wherein measurements are conducted on coordinates at two  
30   (2) points different from each other in a first emit direction

of the laser beam emitted from said laser beam emitting means, a coordinate at one (1) point when changing the emit direction of said laser beam emitting means into a second direction differing from that first direction, and a coordinate at one (1) point when  
5 changing the emit direction of said laser beam emitting means into a third emit direction non-including a plane including both said first emit direction and said second emit direction, and thereby identifying the setting position and direction of said laser emitting means from the emit angle of laser beam and coordinates  
10 of the laser emitting positions, which are measured.

11. A position measuring apparatus, as described in the claim 8, further comprising means for obtaining a target position of laser beam emit in coordinate system, each defining the setting position and direction of said laser beam emitting means, and for  
15 obtaining the emit angle of the laser beam of said laser beam emitting means from the target position.

12. A position measuring apparatus, as described in the claim 8, wherein said laser beam emitting means comprises a plural number of galvano-scanners, and mirrors each being attached  
20 rotatable onto each of said galvano-scanners, and the position and the direction of the surgical tool are indicated by controlling angles of said mirrors.

13 A position measuring apparatus, as described in the claim 8, wherein said calculating means obtains the emit angles for said  
25 laser beam emitting means to emit onto points locating at both ends of a line segment, from coordinates at both ends about the line segment, which include a target position of said tool therein and are defined by the target position and the direction, and the setting position and the direction of said laser beam emitting  
30 means, and said laser beam emitting means control the emit angles obtained for each of said laser beam emitting angles in synchronism with each other.